Claims

1. A mass spectrometer comprising:

an ion mobility separator for separating ions according to their ion mobility, said ion mobility separator comprising a plurality of electrodes wherein in use one or more transient DC voltages or one or more transient DC voltage waveforms are progressively applied to said electrodes so that at least some ions having a first ion mobility are separated from other ions having a second different ion mobility.

2. A mass spectrometer as claimed in claim 1, wherein said one or more transient DC voltages or one or more transient DC voltage waveforms is such that at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% or 95% of said ions having said first ion mobility are substantially moved along said ion mobility separator by said one or more transient DC voltages or said one or more transient DC voltage waveforms as said one or more transient DC voltages or said one or more transient DC voltage waveforms are progressively applied to said electrodes.

3. A mass spectrometer as claimed in claim 1, wherein said one or more transient DC voltages or said one or more transient DC voltage waveforms are such that at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% or 95% of said ions having said second ion mobility are moved along said ion mobility separator by said applied DC voltage to a lesser degree than said ions having said first ion mobility as said one or more transient DC

voltages or said one or more transient DC voltage waveforms are progressively applied to said electrodes.

4. A mass spectrometer as claimed in claim 1, wherein said one or more transient DC voltages or said one or more transient DC voltage waveforms are such that at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% or 95% of said ions having said first ion mobility are moved along said ion mobility separator with a higher velocity than said ions having said second ion mobility.

5. A mass spectrometer comprising:

an ion mobility separator for separating ions according to their ion mobility, said ion mobility separator comprising a plurality of electrodes wherein in use one or more transient DC voltages or one or more transient DC voltage waveforms are progressively applied to said electrodes so that ions are moved towards a region of the ion mobility separator wherein at least one electrode has a potential such that at least some ions having a first ion mobility will pass across said potential whereas other ions having a second different ion mobility will not pass across said potential.

6. A mass spectrometer as claimed in claim 5, wherein said one or more transient DC voltages or said one or more transient DC voltage waveforms are such that at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% or 95% of said ions having said first ion mobility pass across said potential.

7. A mass spectrometer as claimed in claim 5, wherein said one or more transient DC voltages or said one or more transient DC voltage waveforms are such that at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% or 95% of said ions having said second ion mobility will not pass across said potential.

8. A mass spectrometer as claimed in claim 5, wherein said at least one electrode is provided with a voltage such that a potential hill or valley is provided.

9. A mass spectrometer as claimed in claim 5, wherein said one or more transient DC voltages or said one or more transient DC voltage waveforms are such that at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% or 95% of said ions having said first ion mobility exit said ion mobility separator substantially before ions having said second ion mobility.

10. A mass spectrometer as claimed in claim 5, wherein said one or more transient DC voltages or said one or more transient DC voltage waveforms are such that at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% or 95% of said ions having said second ion mobility exit said ion mobility separator substantially after ions having said first ion mobility.

11. A mass spectrometer as claimed in claim 5, wherein a majority of said ions having said first ion mobility exit said ion mobility separator a time t before a majority of said ions having said second ion mobility exit said ion mobility separator, wherein t falls within a range selected from the group consisting of: (i) < 1

μs; (ii) 1-10 μs; (iii) 10-50 μs; (iv) 50-100 μs; (v) 100-200 μs; (vi) 200-300 μs; (vii) 300-400 μs; (viii) 400-500 μs; (ix) 500-600 μs; (x) 600-700 μs; (xi) 700-800 μs; (xii) 800-900 μs; (xiii) 900-1000 μs; (xiv) 1.0-1.1 ms (xv) 1.1-1.2 ms; (xvi) 1.2-1.3 ms; (xvii) 1.3-1.4 ms; (xviii) 1.4-1.5 ms; (xix) 1.5-1.6 ms; (xx) 1.6-1.7 ms; (xxi) 1.7-1.8 ms; (xxii) 1.8-1.9 ms; (xxiii) 1.9-2.0 ms; (xxiv) 2.0-2.5 ms; (xxv) 2.5-3.0 ms; (xxvi) 3.0-3.5 ms; (xxvii) 3.5-4.0 ms; (xxviii) 4.0-4.5 ms; (xxix) 4.5-5.0 ms; (xxx) 5-10 ms; (xxxi) 10-15 ms; (xxxii) 15-20 ms; (xxxiii) 20-25 ms; and (xxxiv) 25-30 ms.

12. A mass spectrometer comprising:

an ion mobility separator for separating ions according to their ion mobility, said ion mobility separator comprising a plurality of electrodes wherein in use one or more transient DC voltages or one or more transient DC voltage waveforms are progressively applied to said electrodes so that:

(i) ions are moved towards a region of the ion mobility separator wherein at least one electrode has a first potential such that at least some ions having first and second different ion mobilities will pass across said first potential whereas other ions having a third different ion mobility will not pass across said first potential; and then

(ii) ions having said first and second ion mobilities are moved towards a region of the ion mobility separator wherein at least one electrode has a second potential such that at least some ions having said first ion mobility will pass across said second potential whereas other ions having said second

different ion mobility will not pass across said second potential.

13. A mass spectrometer as claimed in claim 12, wherein said one or more transient DC voltages or said one or more transient DC voltage waveforms and said first potential are such that at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% or 95% of said ions having said first ion mobility pass across said first potential.

14. A mass spectrometer as claimed in claim 12, wherein said one or more transient DC voltages or said one or more transient DC voltage waveforms and said first potential are such that at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% or 95% of said ions having said second ion mobility pass across said first potential.

15. A mass spectrometer as claimed in claim 12, wherein said one or more transient DC voltages or said one or more transient DC voltage waveforms and said first potential are such that at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% or 95% of said ions having said third ion mobility do not pass across said first potential.

16. A mass spectrometer as claimed in claim 12, wherein said one or more transient DC voltages or said one or more transient DC voltage waveforms and said second potential are such that at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% or 95% of said ions having said first ion mobility pass across said second potential.

17. A mass spectrometer as claimed in claim 12, wherein said one or more transient DC voltages or said one or more transient DC voltage waveforms and said second potential are such that at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% or 95% of said ions having said second ion mobility do not pass across said second potential.

18. A mass spectrometer as claimed in claim 12, wherein said one or more transient DC voltages or said one or more transient DC voltage waveforms are such that at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% or 95% of said ions having said second ion mobility exit said ion mobility separator substantially before ions having said first and third ion mobilities.

19. A mass spectrometer as claimed in claim 12, wherein said one or more transient DC voltages or said one or more transient DC voltage waveforms are such that at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% or 95% of said ions having said first and third ion mobilities exit said ion mobility separator substantially after ions having said second ion mobility.

20. A mass spectrometer as claimed in claim 12, wherein a majority of said ions having said second ion mobility exit said ion mobility separator a time t before a majority of said ions having said first and third ion mobilities exit said ion mobility separator, wherein t falls within a range selected from the group consisting of: (i) < 1 μs; (ii) 1-10 μs; (iii) 10-50 μs; (iv) 50-100 μs; (v) 100-200 μs; (vi) 200-300 μs; (vii) 300-400 μs; (viii) 400-500 μs; (ix) 500-600 μs; (x) 600-700 μs;

(xi) 700-800 µs; (xii) 800-900 µs; (xiii) 900-1000 µs; (xiv) 1.0-1.1 ms (xv) 1.1-1.2 ms; (xvi) 1.2-1.3 ms; (xvii) 1.3-1.4 ms; (xviii) 1.4-1.5 ms; (xix) 1.5-1.6 ms; (xx) 1.6-1.7 ms; (xxi) 1.7-1.8 ms; (xxii) 1.8-1.9 ms; (xxiii) 1.9-2.0 ms; (xxiv) 2.0-2.5 ms; (xxv) 2.5-3.0 ms; (xxvi) 3.0-3.5 ms; (xxvii) 3.5-4.0 ms; (xxviii) 4.0-4.5 ms; (xxix) 4.5-5.0 ms; (xxx) 5-10 ms; (xxxi) 10-15 ms; (xxxii) 15-20 ms; (xxxiii) 20-25 ms; and (xxxiv) 25-30 ms.

21. A mass spectrometer as claimed in claim 12, wherein said one or more transient DC voltages create: (i) a potential hill or barrier; (ii) a potential well; (iii) a combination of a potential hill or barrier and a potential well; (iv) multiple potential hills or barriers; (v) multiple potential wells; or (vi) a combination of multiple potential hills or barriers and multiple potential wells.

22. A mass spectrometer as claimed in claim 12, wherein said one or more transient DC voltage waveforms comprise a repeating waveform.

23. A mass spectrometer as claimed in claim 22, wherein said one or more transient DC voltage waveforms comprise a square wave.

24. A mass spectrometer as claimed in claim 12, wherein said one or more transient DC voltage waveforms create a plurality of potential peaks or wells separated by intermediate regions.

25. A mass spectrometer as claimed in claim 24, wherein the DC voltage gradient in said intermediate regions is non-zero.

26. A mass spectrometer as claimed in claim 25, wherein said DC voltage gradient is positive or negative in said intermediate regions.

27. A mass spectrometer as claimed in claim 25, wherein the DC voltage gradient in said intermediate regions is linear.

28. A mass spectrometer as claimed in claim 25, wherein the DC voltage gradient in said intermediate regions is non-linear.

29. A mass spectrometer as claimed in claim 28, wherein said DC voltage gradient in said intermediate regions increases or decreases exponentially.

30. A mass spectrometer as claimed in claim 24, wherein the amplitude of said potential peaks or wells remains substantially constant.

31. A mass spectrometer as claimed in claim 24, wherein the amplitude of said potential peaks or wells becomes progressively larger or smaller.

32. A mass spectrometer as claimed in claim 31, wherein the amplitude of said potential peaks or wells increases or decreases either linearly or non-linearly.

33. A mass spectrometer as claimed in claim 12, wherein in use an axial DC voltage gradient is maintained along at least a portion of the length of said ion mobility separator and wherein said axial voltage gradient varies with time.

34. A mass spectrometer as claimed in claim 12, wherein said ion mobility separator comprises a first electrode held at a first reference potential, a second electrode held at a second reference potential, and a third electrode held at a third reference potential, wherein:

at a first time t_1 a first DC voltage is supplied to said first electrode so that said first electrode is held at a first potential above or below said first reference potential;

at a second later time t_2 a second DC voltage is supplied to said second electrode so that said second electrode is held at a second potential above or below said second reference potential; and

at a third later time t_3 a third DC voltage is supplied to said third electrode so that said third electrode is held at a third potential above or below said third reference potential.

35. A mass spectrometer as claimed in claim 34, wherein:

at said first time t_1 said second electrode is at said second reference potential and said third electrode is at said third reference potential;

at said second time t_2 said first electrode is at said first potential and said third electrode is at said third reference potential; and

at said third time t_3 said first electrode is at said first potential and said second electrode is at said second potential.

36. A mass spectrometer as claimed in claim 34, wherein:

at said first time t_1 said second electrode is at said second reference potential and said third electrode is at said third reference potential;

at said second time t_2 said first electrode is no longer supplied with said first DC voltage so that said first electrode is returned to said first reference potential and said third electrode is at said third reference potential; and

at said third time t_3 said first electrode is at said first reference potential said second electrode is no longer supplied with said second DC voltage so that said second electrode is returned to said second reference potential.

37. A mass spectrometer as claimed in claim 34, wherein said first, second and third reference potentials are substantially the same.

38. A mass spectrometer as claimed in claim 34, wherein said first, second and third DC voltages are substantially the same.

39. A mass spectrometer as claimed in claim 34, wherein said first, second and third potentials are substantially the same.

40. A mass spectrometer as claimed in claim 12, wherein said ion mobility separator comprises 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30 or >30 segments, wherein each segment comprises 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30 or >30 electrodes and wherein the electrodes in a segment are maintained at substantially the same DC potential.

41. A mass spectrometer as claimed in claim 40, wherein a plurality of segments are maintained at substantially the same DC potential.

42. A mass spectrometer as claimed in claim 40, wherein each segment is maintained at substantially the same DC potential as the subsequent nth segment wherein n is 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30 or >30.

43. A mass spectrometer as claimed in claim 12, wherein ions are confined radially within said ion mobility separator by an AC or RF electric field.

44. A mass spectrometer as claimed in claim 12, wherein ions are radially confined within said ion mobility separator in a pseudo-potential well and are moved axially by a real potential barrier or well.

45. A mass spectrometer as claimed in claim 12, wherein in use one or more AC or RF voltage waveforms are applied to at least some of said electrodes so that ions are urged along at least a portion of the length of said ion mobility separator.

46. A mass spectrometer as claimed in claim 12, wherein the transit time of ions through said ion mobility separator is selected from the group consisting of: (i) less than or equal to 20 ms; (ii) less than or equal to 10 ms; (iii) less than or equal to 5 ms; (iv) less than or equal to 1 ms; and (v) less than or equal to 0.5 ms.

47. A mass spectrometer as claimed in claim 12, wherein said ion mobility separator is maintained in use at a pressure selected from the group consisting of: (i) greater than or equal to 0.0001 mbar; (ii) greater than or equal to 0.0005 mbar; (iii) greater than or equal to 0.001 mbar; (iv) greater than or equal to 0.005 mbar; (v) greater than or equal to 0.01 mbar; (vi) greater than or equal to 0.05 mbar; (vii) greater than or equal to 0.1 mbar; (viii) greater than or equal to 0.5 mbar; (ix) greater than or equal to 1 mbar; (x) greater than or equal to 5 mbar; and (xi) greater than or equal to 10 mbar.

48. A mass spectrometer as claimed in claim 12, wherein said ion mobility separator is maintained in use at a pressure selected from the group consisting of: (i) less than or equal to 10 mbar; (ii) less than or equal to 5 mbar; (iii) less than or equal to 1 mbar; (iv) less than or equal to 0.5 mbar; (v) less than or equal to 0.1 mbar; (vi) less than or equal to 0.05 mbar; (vii) less

than or equal to 0.01 mbar; (viii) less than or equal to 0.005 mbar; (ix) less than or equal to 0.001 mbar; (x) less than or equal to 0.0005 mbar; and (xi) less than or equal to 0.0001 mbar.

49. A mass spectrometer as claimed in claim 12, wherein said ion mobility separator is maintained, in use, at a pressure selected from the group consisting of: (i) between 0.0001 and 10 mbar; (ii) between 0.0001 and 1 mbar; (iii) between 0.0001 and 0.1 mbar; (iv) between 0.0001 and 0.01 mbar; (v) between 0.0001 and 0.001 mbar; (vi) between 0.001 and 10 mbar; (vii) between 0.001 and 1 mbar; (viii) between 0.001 and 0.1 mbar; (ix) between 0.001 and 0.01 mbar; (x) between 0.01 and 10 mbar; (xi) between 0.01 and 1 mbar; (xii) between 0.01 and 0.1 mbar; (xiii) between 0.1 and 10 mbar; (xiv) between 0.1 and 1 mbar; and (xv) between 1 and 10 mbar.

50. A mass spectrometer as claimed in claim 12, wherein said ion mobility separator is maintained, in use, at a pressure such that a viscous drag is imposed upon ions passing through said ion mobility separator.

51. A mass spectrometer as claimed in claim 12, wherein in use said one or more transient DC voltages or said one or more transient DC voltage waveforms are initially provided at a first axial position and are then subsequently provided at second, then third different axial positions along said ion mobility separator.

52. A mass spectrometer as claimed in claim 12, wherein said one or more transient DC voltages or said one or more transient DC voltage waveforms move from one end of

said ion mobility separator to another end of said ion mobility separator so that at least some ions are urged along said ion mobility separator.

53. A mass spectrometer as claimed in claim 12, wherein said one or more transient DC voltages or said one or more transient DC voltage waveforms have at least 2, 3, 4, 5, 6, 7, 8, 9 or 10 different amplitudes.

54. A mass spectrometer as claimed in claim 12, wherein the amplitude of said one or more transient DC voltages or said one or more transient DC voltage waveforms remains substantially constant with time.

55. A mass spectrometer as claimed in claim 12, wherein the amplitude of said one or more transient DC voltages or said one or more transient DC voltage waveforms varies with time.

56. A mass spectrometer as claimed in claim 54, wherein the amplitude of said one or more transient DC voltages or said one or more transient DC voltage waveforms either: (i) increases with time; (ii) increases then decreases with time; (iii) decreases with time; or (iv) decreases then increases with time.

57. A mass spectrometer as claimed in claim 55, wherein said ion mobility separator comprises an upstream entrance region, a downstream exit region and an intermediate region, wherein:

in said entrance region the amplitude of said one or more transient DC voltages or said one or more transient DC voltage waveforms has a first amplitude;

in said intermediate region the amplitude of said one or more transient DC voltages or said one or more transient DC voltage waveforms has a second amplitude; and

in said exit region the amplitude of said one or more transient DC voltages or said one or more transient DC voltage waveforms has a third amplitude.

58. A mass spectrometer as claimed in claim 57, wherein the entrance and/or exit region comprise a proportion of the total axial length of said ion mobility separator selected from the group consisting of: (i) < 5%; (ii) 5-10%; (iii) 10-15%; (iv) 15-20%; (v) 20-25%; (vi) 25-30%; (vii) 30-35%; (viii) 35-40%; and (ix) 40-45%.

59. A mass spectrometer as claimed in claim 57, wherein said first and/or third amplitudes are substantially zero and said second amplitude is substantially non-zero.

60. A mass spectrometer as claimed in claim 57, wherein said second amplitude is larger than said first amplitude and/or said second amplitude is larger than said third amplitude.

61. A mass spectrometer as claimed in claim 12, wherein said one or more transient DC voltages or said one or more transient DC voltage waveforms pass in use along said ion mobility separator with a first velocity.

62. A mass spectrometer as claimed in claim 61, wherein said first velocity: (i) remains substantially constant; (ii) varies; (iii) increases; (iv) increases then

decreases; (v) decreases; (vi) decreases then increases; (vii) reduces to substantially zero; (viii) reverses direction; or (ix) reduces to substantially zero and then reverses direction.

63. A mass spectrometer as claimed in claim 61, wherein said one or more transient DC voltages or said one or more transient DC voltage waveforms causes some ions within said ion mobility separator to pass along said ion mobility separator with a second different velocity.

64. A mass spectrometer as claimed in claim 61, wherein said one or more transient DC voltages or said one or more transient DC voltage waveforms causes some ions within said ion mobility separator to pass along said ion mobility separator with a third different velocity.

65. A mass spectrometer as claimed in claim 61, wherein said one or more transient DC voltages or said one or more transient DC voltage waveforms causes some ions within said ion mobility separator to pass along said ion mobility separator with a fourth different velocity.

66. A mass spectrometer as claimed in claim 61, wherein said one or more transient DC voltages or said one or more transient DC voltage waveforms causes some ions within said ion mobility separator to pass along said ion mobility separator with a fifth different velocity.

67. A mass spectrometer as claimed in claim 61, wherein the difference between said first velocity and said second and/or said third and/or said fourth and/or said fifth velocities is selected from the group consisting

of: (i) less than or equal to 50 m/s; (ii) less than or equal to 40 m/s; (iii) less than or equal to 30 m/s; (iv) less than or equal to 20 m/s; (v) less than or equal to 10 m/s; (vi) less than or equal to 5 m/s; and (vii) less than or equal to 1 m/s;

68. A mass spectrometer as claimed in claim 61, wherein said first velocity is selected from the group consisting of: (i) 10-250 m/s; (ii) 250-500 m/s; (iii) 500-750 m/s; (iv) 750-1000 m/s; (v) 1000-1250 m/s; (vi) 1250-1500 m/s; (vii) 1500-1750 m/s; (viii) 1750-2000 m/s; (ix) 2000-2250 m/s; (x) 2250-2500 m/s; (xi) 2500-2750 m/s; and (xii) 2750-3000 m/s.

69. A mass spectrometer as claimed in claim 61, wherein said second and/or said third and/or said fourth and/or said fifth velocity is selected from the group consisting of: (i) 10-250 m/s; (ii) 250-500 m/s; (iii) 500-750 m/s; (iv) 750-1000 m/s; (v) 1000-1250 m/s; (vi) 1250-1500 m/s; (vii) 1500-1750 m/s; (viii) 1750-2000 m/s; (ix) 2000-2250 m/s; (x) 2250-2500 m/s; (xi) 2500-2750 m/s; and(xii) 2750-3000 m/s.

70. A mass spectrometer as claimed in claim 12, wherein said one or more transient DC voltages or said one or more transient DC voltage waveforms has a frequency, and wherein said frequency: (i) remains substantially constant; (ii) varies; (iii) increases; (iv) increases then decreases; (v) decreases; or (vi) decreases then increases.

71. A mass spectrometer as claimed in claim 12, wherein said one or more transient DC voltages or said one or more transient DC voltage waveforms has a wavelength, and wherein said wavelength: (i) remains substantially constant; (ii) varies; (iii) increases; (iv) increases then decreases; (v) decreases; or (vi) decreases then increases.

72. A mass spectrometer as claimed in claim 12, wherein two or more transient DC voltages or two or more transient DC voltage waveforms pass simultaneously along said ion mobility separator.

73. A mass spectrometer as claimed in claim 72, wherein said two or more transient DC voltages or said two or more transient DC voltage waveforms are arranged to move: (i) in the same direction; (ii) in opposite directions; (iii) towards each other; or (iv) away from each other.

74. A mass spectrometer as claimed in claim 12, wherein said one or more transient DC voltages or said one or more transient DC voltage waveforms passes along said ion mobility separator and at least one substantially stationary transient DC potential voltage or voltage waveform is provided at a position along said ion mobility separator.

75. A mass spectrometer as claimed in claim 12, wherein said one or more transient DC voltages or said one or more transient DC voltage waveforms are repeatedly generated and passed in use along said ion mobility separator, and wherein the frequency of generating said

one or more transient DC voltages or said one or more transient DC voltage waveforms: (i) remains substantially constant; (ii) varies; (iii) increases; (iv) increases then decreases; (v) decreases; or (vi) decreases then increases.

76. A mass spectrometer as claimed in claim 12, wherein in use a continuous beam of ions is received at an entrance to said ion mobility separator.

77. A mass spectrometer as claimed in claim 12, wherein in use packets of ions are received at an entrance to said ion mobility separator.

78. A mass spectrometer as claimed in claim 12, wherein in use pulses of ions emerge from an exit of said ion mobility separator.

79. A mass spectrometer as claimed in claim 78, further comprising an ion detector, said ion detector being arranged to be substantially phase locked in use with the pulses of ions emerging from the exit of the ion mobility separator.

80. A mass spectrometer as claimed in claim 78, further comprising a Time of Flight mass analyser comprising an electrode for injecting ions into a drift region, said electrode being arranged to be energised in use in a substantially synchronised manner with the pulses of ions emerging from the exit of the ion mobility separator.

81. A mass spectrometer as claimed in claim 12, wherein said ion mobility separator is selected from the group consisting of: (i) an ion funnel comprising a plurality of electrodes having apertures therein through which ions are transmitted, wherein the diameter of said apertures becomes progressively smaller or larger; (ii) an ion tunnel comprising a plurality of electrodes having apertures therein through which ions are transmitted, wherein the diameter of said apertures remains substantially constant; and (iii) a stack of plate, ring or wire loop electrodes.

82. A mass spectrometer as claimed in claim 12, wherein said ion mobility separator comprises a plurality of electrodes, each electrode having an aperture through which ions are transmitted in use.

83. A mass spectrometer as claimed in claim 12, wherein each electrode has a substantially circular aperture.

84. A mass spectrometer as claimed in claim 12, wherein each electrode has a single aperture through which ions are transmitted in use.

85. A mass spectrometer as claimed in claim 82, wherein the diameter of the apertures of at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% or 95% of the electrodes forming said ion mobility separator is selected from the group consisting of: (i) less than or equal to 10 mm; (ii) less than or equal to 9 mm; (iii) less than or equal to 8 mm; (iv) less than or equal to 7 mm; (v) less than or equal to 6 mm; (vi) less than or equal to 5 mm; (vii) less than or equal to 4 mm; (viii) less than or

equal to 3 mm; (ix) less than or equal to 2 mm; and (x) less than or equal to 1 mm.

86. A mass spectrometer as claimed in claim 12, wherein at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% or 95% of the electrodes forming the ion mobility separator have apertures which are substantially the same size or area.

87. A mass spectrometer as claimed in claim 12, wherein said ion mobility separator comprises a segmented rod set.

88. A mass spectrometer as claimed in claim 12, wherein said ion mobility separator consists of: (i) 10-20 electrodes; (ii) 20-30 electrodes; (iii) 30-40 electrodes; (iv) 40-50 electrodes; (v) 50-60 electrodes; (vi) 60-70 electrodes; (vii) 70-80 electrodes; (viii) 80-90 electrodes; (ix) 90-100 electrodes; (x) 100-110 electrodes; (xi) 110-120 electrodes; (xii) 120-130 electrodes; (xiii) 130-140 electrodes; (xiv) 140-150 electrodes; or (xv) more than 150 electrodes.

89. A mass spectrometer as claimed in claim 12, wherein the thickness of at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% or 95% of said electrodes is selected from the group consisting of: (i) less than or equal to 3 mm; (ii) less than or equal to 2.5 mm; (iii) less than or equal to 2.0 mm; (iv) less than or equal to 1.5 mm; (v) less than or equal to 1.0 mm; and (vi) less than or equal to 0.5 mm.

90. A mass spectrometer as claimed in claim 12, wherein said ion mobility separator has a length selected from the group consisting of: (i) less than 5 cm; (ii) 5-10 cm; (iii) 10-15 cm; (iv) 15-20 cm; (v) 20-25 cm; (vi) 25-30 cm; and (vii) greater than 30 cm.

91. A mass spectrometer as claimed in claim 12, wherein at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, or 95% of said electrodes are connected to both a DC and an AC or RF voltage supply.

92. A mass spectrometer as claimed in claim 12, wherein axially adjacent electrodes are supplied with AC or RF voltages having a phase difference of 180°.

93. A mass spectrometer as claimed in claim 12, further comprising an ion source selected from the group consisting of: (i) Electrospray ("ESI") ion source; (ii) Atmospheric Pressure Chemical Ionisation ("APCI") ion source; (iii) Atmospheric Pressure Photo Ionisation ("APPI") ion source; (iv) Matrix Assisted Laser Desorption Ionisation ("MALDI") ion source; (v) Laser Desorption Ionisation ("LDI") ion source; (vi) Inductively Coupled Plasma ("ICP") ion source; (vii) Electron Impact ("EI) ion source; (viii) Chemical Ionisation ("CI") ion source; (ix) a Fast Atom Bombardment ("FAB") ion source; and (x) a Liquid Secondary Ions Mass Spectrometry ("LSIMS") ion source.

94. A mass spectrometer as claimed in claim 12, further comprising a continuous ion source.

95. A mass spectrometer as claimed in claim 12, further comprising a pulsed ion source.

96. An ion mobility separator for separating ions according to their ion mobility, said ion mobility separator comprising a plurality of electrodes wherein in use one or more transient DC voltages or one or more transient DC voltage waveforms are progressively applied to said electrodes so that at least some ions having a first ion mobility are separated from other ions having a second different ion mobility.

97. An ion mobility separator for separating ions according to their ion mobility, said ion mobility separator comprising a plurality of electrodes wherein in use one or more transient DC voltages or one or more transient DC voltage waveforms are progressively applied to said electrodes so that ions are moved towards a region of the ion mobility separator wherein at least one electrode has a potential such that at least some ions having a first ion mobility will pass across said potential whereas other ions having a second different ion mobility will not pass across said potential.

98. An ion mobility separator for separating ions according to their ion mobility, said ion mobility separator comprising a plurality of electrodes wherein in use one or more transient DC voltages or one or more transient DC voltage waveforms are progressively applied to said electrodes so that:

(i) ions are moved towards a region of the ion mobility separator wherein at least one electrode has a first potential such that at least some ions having

first and second different ion mobilities will pass across said first potential whereas other ions having a third different ion mobility will not pass across said first potential; and then

(ii) ions having said first and second ion mobilities are moved towards a region of the ion mobility separator wherein at least one electrode has a second potential such that at least some ions having said first ion mobility will pass across said second potential whereas other ions having said second different ion mobility will not pass across said second potential.

99. A method of mass spectrometry comprising:

receiving ions in an ion mobility separator comprising a plurality of electrodes; and

progressively applying to said electrodes one or more transient DC voltages or one or more transient DC voltage waveforms so that at least some ions having a first ion mobility are separated from other ions having a second different ion mobility.

100. A method of mass spectrometry comprising:

receiving ions in an ion mobility separator comprising a plurality of electrodes; and

progressively applying to said electrodes one or more transient DC voltages or one or more transient DC voltage waveforms so that ions are moved towards a region of the ion mobility separator wherein at least one electrode has a potential such that at least some ions having a first ion mobility will pass across said potential whereas other ions having a second different ion mobility will not pass across said potential.

101. A method of mass spectrometry comprising:

receiving ions in an ion mobility separator comprising a plurality of electrodes;

progressively applying to said electrodes one or more transient DC voltages or one or more transient DC voltage waveforms so that ions are moved towards a region of the ion mobility separator wherein at least one electrode has a first potential such that at least some ions having a first and second different ion mobilities will pass across said first potential whereas other ions having a third different ion mobility will not pass across said first potential; and then

progressively applying to said electrodes one or more transient DC voltages or one or more transient DC voltage waveforms so that ions having said first and second ion mobilities are moved towards a region of the ion mobility separator wherein at least one electrode has a second potential such that at least some ions having said first ion mobility will pass across said second potential whereas other ions having said second different ion mobility will not pass across said second potential.

102. A method of ion mobility separation comprising:

receiving ions in an ion mobility separator comprising a plurality of electrodes; and

progressively applying to said electrodes one or more transient DC voltages or one or more transient DC voltage waveforms so that at least some ions having a first ion mobility are separated from other ions having a second different ion mobility.

103. A method of ion mobility separation comprising:

receiving ions in an ion mobility separator comprising a plurality of electrodes; and

progressively applying to said electrodes one or more transient DC voltages or one or more transient DC voltage waveforms so that ions are moved towards a region of the ion mobility separator wherein at least one electrode has a potential such that at least some ions having a first ion mobility will pass across said potential whereas other ions having a second different ion mobility will not pass across said potential.

104. A method of ion mobility separation comprising:

receiving ions in an ion mobility separator comprising a plurality of electrodes;

progressively applying to said electrodes one or more transient DC voltages or one or more transient DC voltage waveforms so that ions are moved towards a region of the ion mobility separator wherein at least one electrode has a first potential such that at least some ions having a first and second different ion mobilities will pass across said first potential whereas other ions having a third different ion mobility will not pass across said first potential; and then

progressively applying to said electrodes one or more transient DC voltages or one or more transient DC voltage waveforms so that ions having said first and second ion mobilities are moved towards a region of the ion mobility separator wherein at least one electrode has a second potential such that at least some ions having said first ion mobility will pass across said second potential whereas other ions having said second

different ion mobility will not pass across said second potential.

105. An ion mobility separator wherein ions separate within said ion mobility separator according to their ion mobility and assume different essentially static or equilibrium axial positions along the length of said ion mobility separator.

106. An ion mobility separator as claimed in claim 105, wherein said ion mobility separator comprises a plurality of electrodes and wherein one or more transient DC voltages or one or more transient DC voltage waveforms are progressively applied to said electrodes so as to urge at least some ions in a first direction and wherein a DC voltage gradient acts to urge at least some ions in a second direction, said second direction being opposed to said first direction.

107. An ion mobility separator as claimed in claim 106, wherein the peak amplitude of said one or more transient DC voltages or said one or more transient DC voltage waveforms remains substantially constant or reduces along the length of the ion mobility separator.

108. An ion mobility separator as claimed in claim 106, wherein said DC voltage gradient progressively increases along the length of the ion mobility separator.

109. An ion mobility separator as claimed in claim 105, wherein once ions have assumed essentially static or equilibrium axial positions along the length of said ion mobility separator at least some of said ions are then

arranged to be moved towards an exit of said ion mobility separator.

110. An ion mobility separator as claimed in claim 109, wherein at least some of said ions are arranged to be moved towards an exit of said ion mobility separator by: (i) reducing or increasing an axial DC voltage gradient; (ii) reducing or increasing the peak amplitude of said one or more transient DC voltages or said one or more transient DC voltage waveforms; (iii) reducing or increasing the velocity of said one or more transient DC voltages or said one or more transient DC voltage waveforms; or (iv) reducing or increasing the pressure within said ion mobility separator.

111. A mass spectrometer comprising an ion mobility separator as claimed in claim 105.

112. A method of ion mobility separation comprising causing ions to separate within an ion mobility separator and assume different essentially static or equilibrium axial positions along the length of the ion mobility separator.

113. A method of ion mobility separation as claimed in claim 112, wherein said ion mobility separator comprises a plurality of electrodes and wherein one or more transient DC voltages or one or more transient DC voltage waveforms are progressively applied to said electrodes so as to urge at least some ions in a first direction and wherein a DC voltage gradient acts to urge at least some ions in a second direction, said second direction being opposed to said first direction.

114. A method of ion mobility separation as claimed in claim 113, wherein the peak amplitude of said one or more transient DC voltages or said one or more transient DC voltage waveforms remains substantially constant or reduces along the length of the ion mobility separator.

115. A method of ion mobility separation as claimed in claim 113, wherein said DC voltage gradient progressively increases along the length of the ion mobility separator.

116. A method of ion mobility separation as claimed in claim 112, wherein once ions have assumed essentially static or equilibrium axial positions along the length of said ion mobility separator at least some of said ions are then arranged to be moved towards an exit of said ion mobility separator.

117. A method of ion mobility separation as claimed in claim 116, wherein at least some of said ions are arranged to be moved towards an exit of said ion mobility separator by: (i) reducing or increasing an axial DC voltage gradient; (ii) reducing or increasing the peak amplitude of said one or more transient DC voltages or said one or more transient DC voltage waveforms; (iii) reducing or increasing the velocity of said one or more transient DC voltages or said one or more transient DC voltage waveforms; or (iv) reducing or increasing the pressure within said ion mobility separator.

118. A method of mass spectrometry comprising the method of ion mobility separation as claimed in claim 112.

119. A method of mass spectrometry comprising:

providing an ion mobility separator for separating ions according to their ion mobility, said ion mobility separator comprising a plurality of electrodes wherein in use one or more transient DC voltages or one or more transient DC voltage waveforms are progressively applied to said electrodes so that at least some ions having a first ion mobility are separated from other ions having a second different ion mobility;

separating ions according to their ion mobility in said ion mobility separator;

providing a quadrupole mass filter downstream of said ion mobility separator; and

scanning said quadrupole mass filter in a stepped manner in synchronisation with said ion mobility separator so as to onwardly transmit ions having a desired charge state.

120. A mass spectrometer comprising:

an ion mobility separator for separating ions according to their ion mobility, said ion mobility separator comprising a plurality of electrodes wherein in use one or more transient DC voltages or one or more transient DC voltage waveforms are progressively applied to said electrodes so that at least some ions having a first ion mobility are separated from other ions having a second different ion mobility; and

a quadrupole mass filter downstream of said ion mobility separator;

wherein said quadrupole mass filter is scanned in use in a stepped manner in synchronisation with said ion mobility separator so as to onwardly transmit ions having a desired charge state.